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Kernel Splitter and Inspection Belt for PEANUTS

Marketing Research Report No. [illegible]

Market Quality Research Division
Agricultural Marketing Service
U.S. Department of Agriculture
in cooperation with
Agricultural Engineering Department
North Carolina State College of
Agriculture and Engineering

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PREFACE

This study is part of a broad program of marketing research designed to maintain quality of farm products, develop and expand markets, improve marketing services, and hold down costs and increase efficiency in marketing farm products. This phase of the program is conducted to develop techniques, methods, and devices for the objective measurement of quality factors in agricultural commodities.

The Federal-State Inspection Service in Alabama, Georgia, North Carolina, and Virginia assisted in the study. Personnel from the inspection services in these States helped set forth design requirements and carried out tests of the equipment described in this report. Personnel of the Fruit and Vegetable Division cooperated in the development of the equipment.

Growth Through Agricultural Progress

Washington, D. C. February 1961

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KERNEL SPLITTER AND INSPECTION BELT FOR PEANUTS

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Field Crops and Animal Products Branch
Market Quality Research Division

SUMMARY

A mechanical method for splitting peanut kernels and arranging the halves (the cotyledons) with their flat or inner surfaces exposed for visual examination as a part of official sample inspection, has been devised. A method has been developed also to arrange the peanut halves for visual inspection of their rounded or outer surfaces.

These methods have been incorporated into flow-type machines, now used in official inspection procedure as aids in splitting and examining samples of peanuts for concealed damage. The same or similar machines are being used also to inspect samples from peanuts which have been split open during the shelling operation in commercial shelling plants. These machines save nearly half a man-hour of labor per 1,000-gram sample inspected.

Similar techniques also may be used on picking tables in peanut processing plants or for the internal inspection of other dicotyledonous seeds.

BACKGROUND

In grading peanuts, external damage is determined by visual inspection of the whole kernels. In order to determine the amount of concealed or internal damage represented by rotten, moldy, discolored, or otherwise defective kernels, it is necessary to split each kernel into its two halves (cotyledons) so that their inner surfaces may be examined visually. In addition, for some varieties, it is necessary to inspect the rounded side of the cotyledons for damage after the seed coat or skin has been removed. It is also necessary to inspect both sides of the cotyledons for damage when grading peanuts that are split in commercial shelling operations.

Until recently, the tool generally used for splitting peanut kernels was the knife. The inspector spread the peanuts on a table and cut them open (fig. 1). As each kernel was split, it was examined for damage. This procedure was necessary for farmers' stock peanuts and for commercially shelled peanuts. Such a procedure was so slow that it was necessary to grade small samples in order to keep the time and labor requirements within reason, although it was recognized that a larger sample would be more representative. The inspector was unable to cut each kernel along the suture, and often cut the kernel across the cotyledons. As a result, the faces of the cotyledons remained pressed together so that any discoloration present was hidden.

KERNEL SPLITTER

When peanut kernels are thrown against a hard surface, they split upon impact. Percentage of moisture and other factors, including the type of peanut, affect the amount of force required to split the halves (cotyledons) apart. If the kernels strike with too much force, the cotyledons are shattered. The objective is to split the cotyledons apart along their divisions without shattering them, since shattering makes it difficult, if not impossible, to detect and pick out all the damage.

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Figure 1. --Hand splitting peanut kernels.

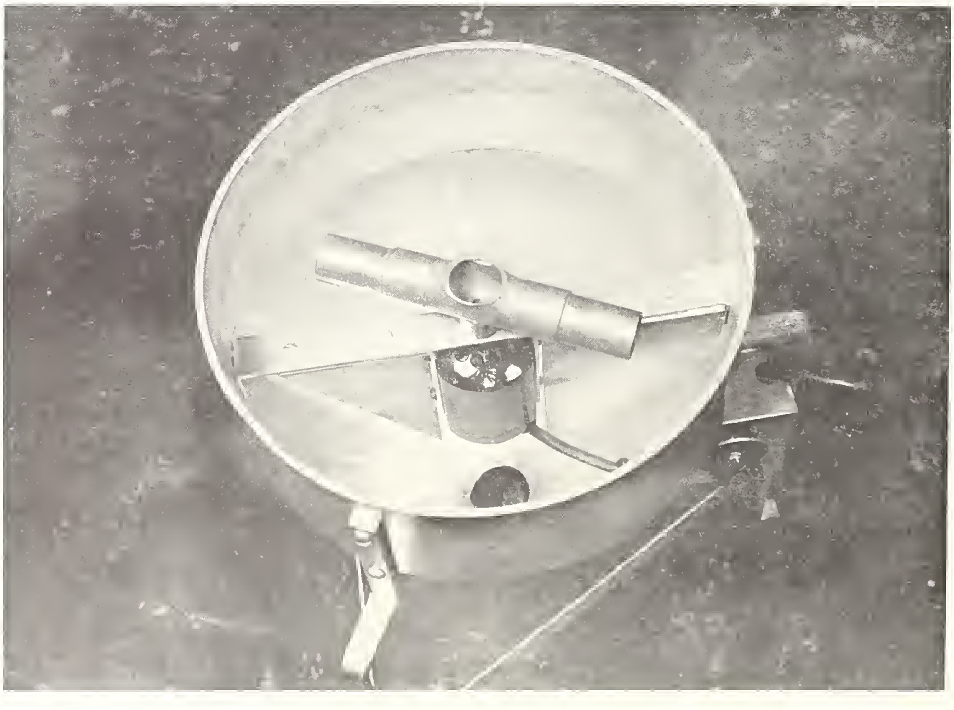

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Figure 2. --Device for splitting peanut kernels.

The device shown in figure 2 was designed to split peanut kernels. The kernels are fed into the opening in the center of the 7-inch tube, which is rotated by the vertical shaft of a motor. The kernels are thrown out of the ends of the tube, and strike the steel cylinder surrounding the tube or impeller. They then fall through the funnel mounted directly beneath the cylinder. The force with which the kernels strike the steel cylinder is dependent upon the speed of revolution of the impeller. A universal motor is used to turn the impeller, since the speed of this type of motor can be regulated with a simple voltage control. By this means, the revolutions per minute (rpm) of the impeller may be adjusted so that as many as possible of the peanuts are split without excessive breakage.

Tests indicate that the impact force required to split all the kernels in a sample causes too much shattering. Figure 3 shows the relationship between the amount of breakage and the percentage of peanuts split at various impeller speeds for extra large Virginia-type peanuts containing 5 percent moisture. Breakage is determined by measuring the small particles, including hearts, which pass through a 14/64-inch round perforated screen. The curve may be shifted for other moisture levels and types of peanuts,

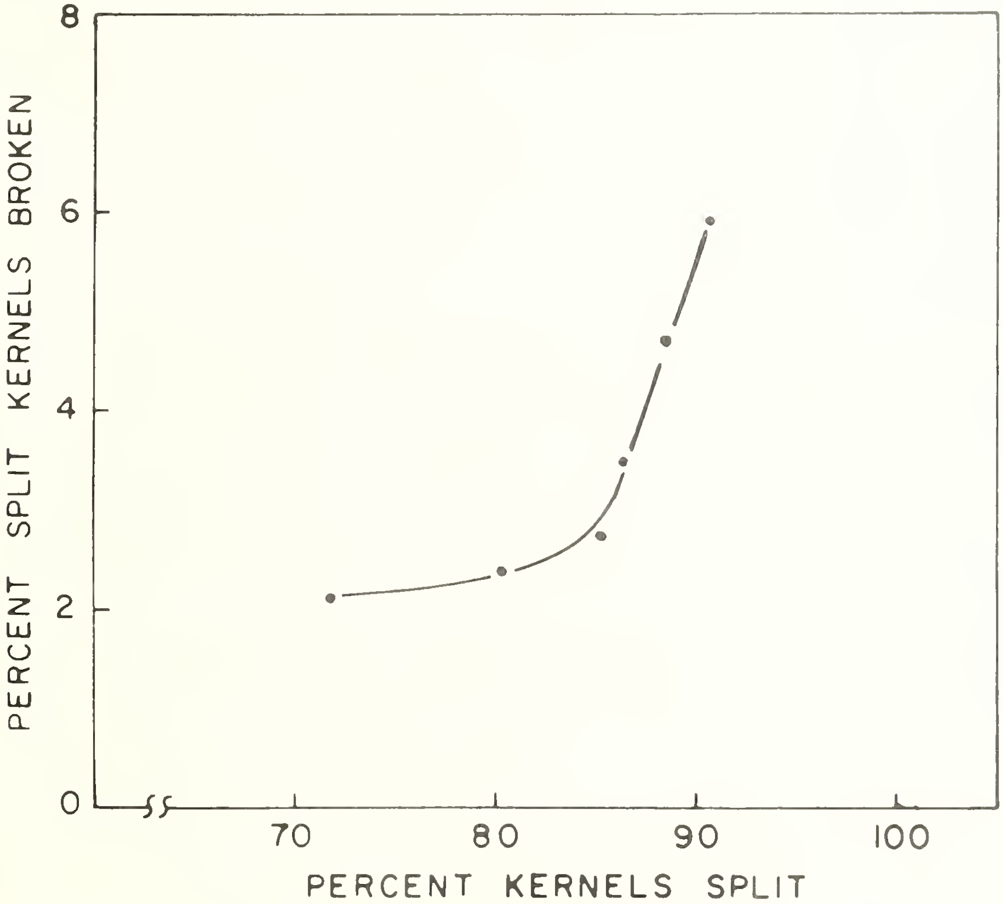

Figure 3. --Relationship between breakage and degree of splitting of peanuts.

but the relationship between breakage and splitting remains fairly constant. This relationship indicates that the optimum splitting force for a given sample of peanuts is one that splits approximately 85 percent of the kernels. The splitting force of the machine can then be increased to split the remainder of the sample.

To determine whether the type of impact surface has an effect on the relationship between breakage and splitting, several types of coverings were tested on the inner surface of the steel cylinder. The surfaces tested were felt, sponge rubber, and hard corrugated rubber. The tests indicated that the smooth surface of the steel cylinder was better than any of the other surfaces tried.

Several impeller lengths for the splitter were tried. Most universal motors turn at 3,500 rpm or more. Since tests showed that the impeller should have a peripheral velocity of about 2,669 feet per minute to split peanuts, it was desirable to select an impeller length that would allow the motor to turn as fast as possible while allowing its peripheral velocity to be controlled around 2,669 feet per minute. On the other hand, the impeller could not be too short or the kernels would not be directed in a horizontal path before being discharged. A scattered pattern of discharge would cause the kernels to strike the cylinder at various angles, which might cause them to bounce back into the impeller and be shattered or prevent them from splitting at all. Tests indicated the peripheral radius of the impeller should be about 3 1/2 inches. This impeller length requires about 1,450 rpm to split peanuts.

The relationship between the impeller length and the cylinder diameter is important, since it is necessary to prevent the cotyledons from bouncing back into the impeller and being shattered. A clearance of 2 1/2 inches between the tips of the impeller and the cylinder wall is satisfactory.

POSITIONING COTYLEDONS WITH THEIR FLAT SIDES UPWARD

When placed in a strong upward flow of air, the rounded side of the peanut half (cotyledon) turns downward. This observation was used in developing a means of positioning peanut cotyledons face upward.

Cotyledons were placed on a piece of 1/8-inch mesh screen and passed over an upward stream of air. The velocity of airflow was found to be critical, since cotyledons were blown off the screen if the air velocity was too high, or were not properly positioned if the air velocity was too low. Because the cotyledons varied in shape and size, no one air velocity was correct for all of them.

Air velocity adjustment was made less critical by placing a perforated metal plate in the air stream immediately below the peanut cotyledons. The perforations were 15/64 inch wide by 3/4 inch long and were 3/16 inch apart. The 3/16-inch rib between the perforations makes a dead air space in which the cotyledons tend to ride and not be lifted if their rounded sides are downward. If a flat side is downward, it protrudes over the edge of the perforation and into the air stream, which flips the cotyledon over. Although the rounded side of the cotyledons may protrude over into the airflow, the force of the air on the rounded surface has a horizontal component which tends to center the cotyledon over the rib between the perforations, and does not exert enough upward force to lift the cotyledon.

When the perforated metal plate is used, satisfactory adjustment of airflow for all types of peanut cotyledons can be obtained by a simple damper adjustment on the fan. Tests show that 612 cubic feet per minute (cfm) of airflow per square foot of perforated metal is sufficient for positioning Virginia, Runner, and Spanish peanut cotyledons. A plate having 15/64- by 3/4-inch oblong perforations 7/16 inch on centers, was used in the tests. The peanuts were supported by an 18- by 14-mesh saran screening, placed directly on the perforated metal plate. The static pressure required for 612 cfm airflow per square foot of perforated metal and saran screening was 1/4 inch of water.

POSITIONING COTYLEDONS WITH THEIR ROUNDED SIDES UPWARD

After the flat sides of peanut cotyledons have been turned upward, a system of converging conveyor belts can invert the cotyledons so that their rounded sides are turned upward. Figure 4 shows the manner in which a belt is brought downward against the flat sides of the cotyledons and held there until the cotyledons have been inverted and presented on the belt with their rounded sides turned upward for visual inspection.

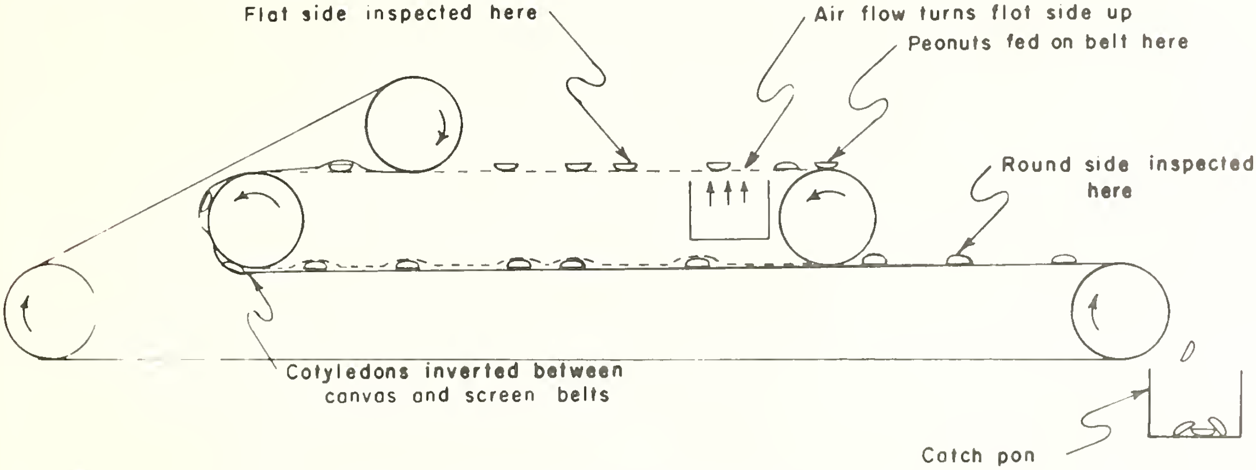

Figure 4. --Belt for inspecting both sides of peanut kernels.

MACHINES THAT UTILIZE THE METHODS DESCRIBED

Figure 5 shows the simplest and least expensive equipment developed for splitting the peanut kernels and positioning the halves for inspection of their flat sides. First, the peanuts are poured into the impeller of the splitter by hand. From the splitter, the cotyledons fall into a screen-bottomed tray. The tray is then passed over an air stream passing upward through a perforated metal plate. The box to which the fan is fastened serves as a plenum so that there will be a uniform air flow through the perforated plate. A damper is located on the side of the plenum box to permit adjustment of airflow for properly positioning the cotyledons. A voltage regulator for controlling the speed of the impeller motor is mounted on the splitter.

A splitting machine with an inspection belt is shown in figure 6. The kernels are placed in the hopper, from which they are fed into the splitting chamber. After being split, they fall on a vibrating screen, which allows the split kernels to fall on the inspection belt, but places the whole kernels in a catch pan so that they can be passed through the splitter again.

The inspection belt is constructed from 18- by 14-mesh saran screen. The belt carries the peanuts over an air stream which is moving upward through a perforated metal plate, and the peanuts are positioned with their flat sides upward for visual inspection. The fan and hood mounted over the inspection belt are used to catch the skins and small particles which would otherwise be blown on the floor. The fan discharges into a small cloth bag which traps the small particles.

Knobs on the machine control the rotation of the impeller in the splitting chamber and the belt speed. This control is obtained by means of a voltage regulator for the universal motor driving the splitter impeller and the universal motor driving the inspection belt through a gear reduction unit. A foot switch is provided to stop and start the inspection belt and feed hopper.

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Splitting

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Inspecting

Figure 5. --Simple method for splitting peanut kernels and inspecting their cotyledons.

Figure 7 shows the peanuts as they are being inspected for concealed damage. After passing the inspector, the cotyledons fall into a catch pan at the end of the belt. This machine enables a considerable reduction in the time required to inspect a sample, as is shown in the following tabulation.

Time Required to Split and Inspect 1,000 Grams of Peanuts

Type of peanuts	By machine	By hand
	Minutes	*Minutes*
Spanish	8	36
Runner	8	36
Extra Large Virginia	4	23
Medium Virginia	7	36

Tests conducted with the machine in cooperation with the Federal-State Inspection Service at Williamston, North Carolina, indicate that more damage can be detected when kernels are split with machine than when split by hand. This difference is thought to be due to the fact that the machine splits the kernels along the suture and exposes the inner surface of the cotyledons where the discoloration is usually found. When the kernels are cut with a knife, they often fail to split this way.

A machine for splitting peanut kernels and inspecting both surfaces of the cotyledons is shown in figure 8. This machine has an inspection belt similar to the one illustrated in figure 4. A machine having this type of inspection belt is useful when it is necessary to examine peanuts for pitting damage. The skins are usually knocked off in the splitting operation so that the rounded surface of the cotyledon can be inspected. Also, the machine

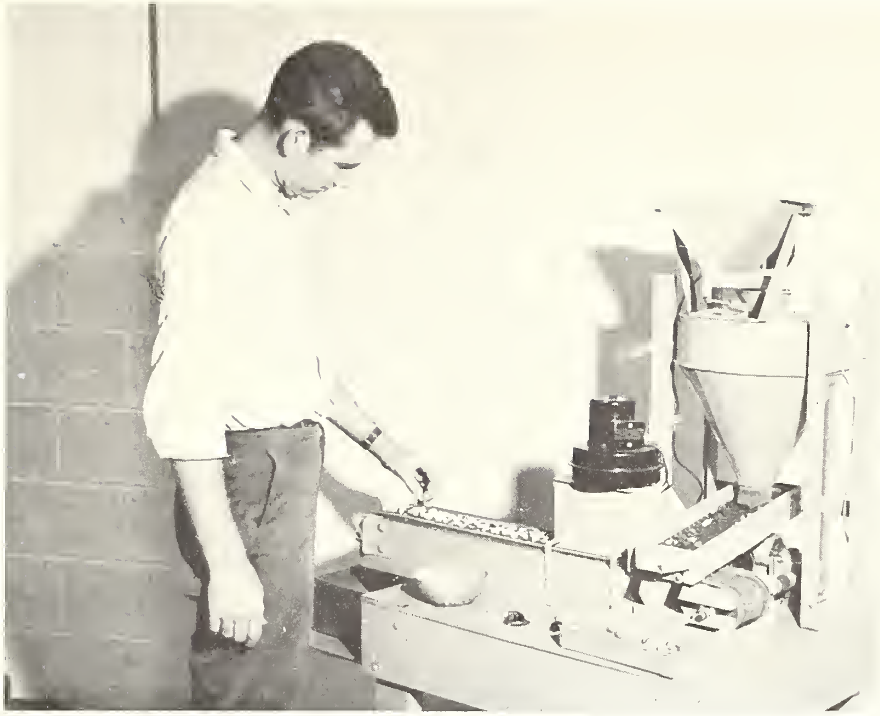

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Figure 6. --A machine for splitting kernels and inspecting the flat side of the cotyledons.

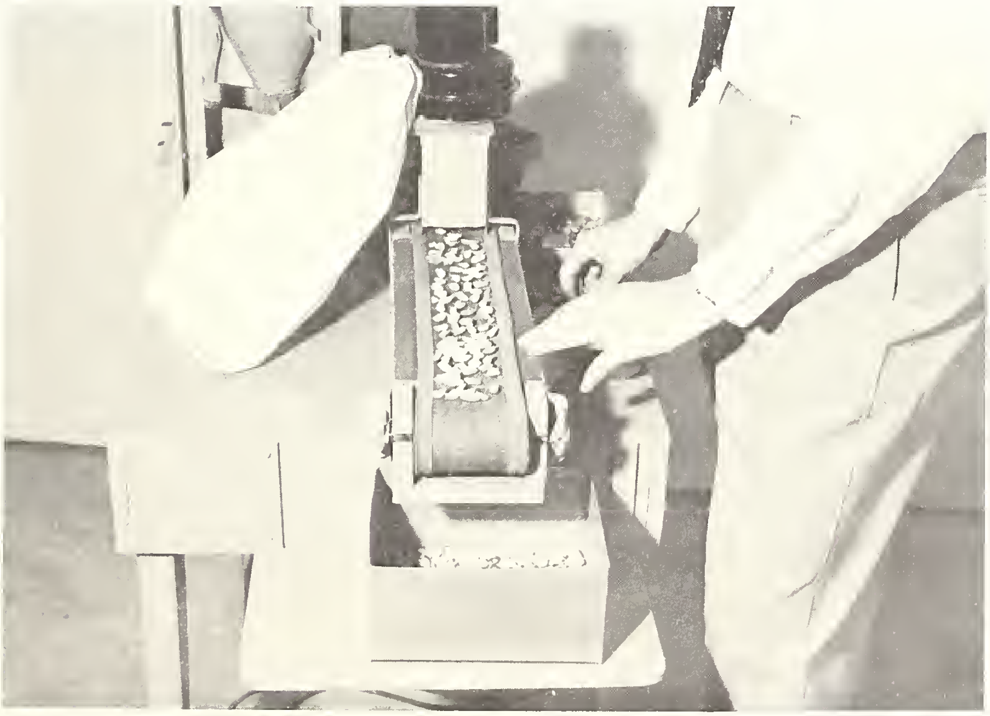

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Figure 7. --Peanuts being inspected on the inspection belt.

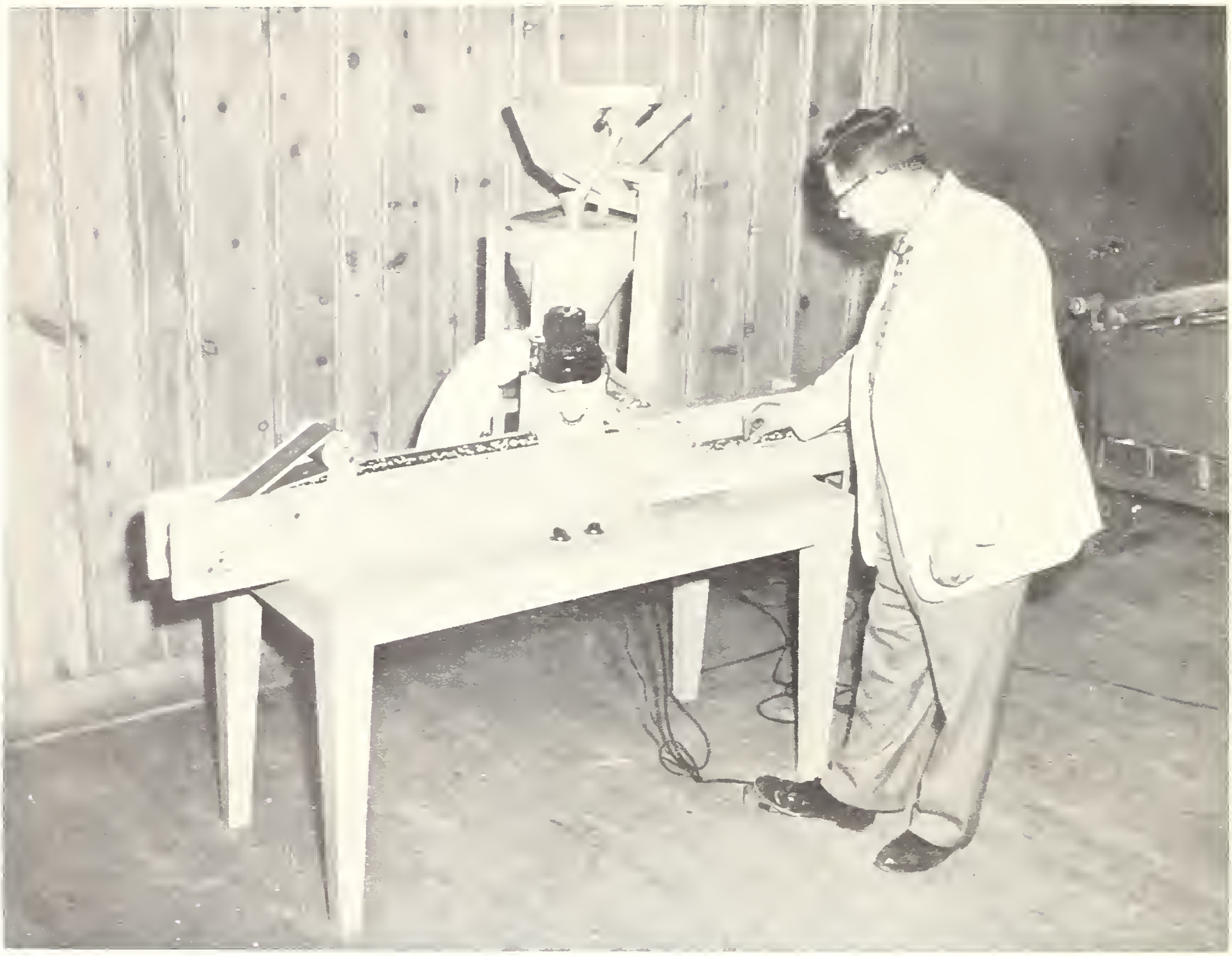

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Figure 8. --A machine for splitting peanut kernels and inspecting both sides of the cotyledons.

is useful for inspecting peanuts which have been split by commercial shelling operations. An attachment on the feed hopper allows the split kernels to bypass the splitter impeller and fall on the inspection belt where both sides of the halves can be inspected for damage.

Although the methods described for splitting and orienting peanuts were designed for use of the Federal-State Inspection Service in the inspection of peanut samples, they may also have industrial applications in peanut processing plants. After roasting, nearly all of the skins are removed from the peanut kernels during the splitting operation. The hearts are separated or are exposed for easy separation from the halves. The orientation method can be used on picking belts. The same principles may be applicable also for splitting and orienting the halves of seeds from other dicotyledons for internal inspection.

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